

PRINT QUEUE MANAGER

BACKGROUND OF THE INVENTION

5 Field of the Invention

The invention concerns the administration of printing devices in a network environment. In particular, the invention concerns the creation and management of print queues corresponding to printing
10 devices connected on a network.

Incorporation By Reference

U.S. Patent Application No. 09/664,531, entitled "Object-Based Architecture For Supporting
15 Network Devices," filed September 18, 2000, is incorporated by reference as if fully set forth in full herein.

Description of the Related Art

20 The administration of printing devices in a network environment is typically a tedious and time consuming task for network administrators. In particular, for large and complex network environments having several local servers, there may be a large
25 number of printers distributed throughout the network. Network administrators must not only install new printing devices on the network, they must also create and manage the print queues associated with the

printing devices and facilitate network users connecting to and utilizing the printing devices.

In large computer networking environments, the administrative tasks required to create and
5 configure print queues associated with printing devices connected to the network can be demanding. For example, when creating a print queue for a printing device, a network administrator generally must manually enter information such as the address assigned to the
10 printing device, the particular type of printing device, and the configuration or capabilities of the printing device. As the number of printing devices increases, the time and effort required to obtain the needed information and create and configure the
15 necessary print queues can become excessively burdensome.

Once a print queue has been created and configured for a particular printing device, network users may begin utilizing the printing device by
20 locating and connecting to the desired print queue, and installing any necessary print drivers. However, searching for the desired print queue often requires the network user to search lists of print queues on multiple network servers. In networking environments
25 employing a large number of servers, finding a desired print queue can be confusing and very time consuming.

As printing devices within an existing computer network are relocated or reassigned addresses, typically a network administrator must update the
30 configuration stored for the respective print queues to reflect any change of address on the network. Additionally, if the name of a print queue is changed, all user workstations using that particular print queue must be updated with the new name or the user
35 workstations will lose their connection to the printing device. As the size of the computer network increases, updating print queue configuration information and

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ensuring all workstations have updated print queue names becomes very time consuming.

SUMMARY OF THE INVENTION

5 The present invention addresses the foregoing
problems by providing for the automatic creation and
configuration of print queues upon detecting printing
devices on a network. Specifically, the invention
detects new printing devices connected on a network.
10 Upon detection of a printing device, information is
obtained from the detected printing device and a print
queue is created. Accordingly, the present invention
helps reduce the burden of manually creating and
configuring print queues for connected printing
15 devices.

One aspect of the invention concerns detecting a printing device connected on a network and requesting information from the detected printing device. The requested information is received from the printing device and a print queue is created for the printing device based on the received information.

The invention preferably includes detecting a printing device by detecting an address assignment message sent between an address server and the printing device over the network. The invention also includes detecting the printing device by sending a request message to a plurality of network addresses and receiving a response message from the printing device located at one of the network addresses. Additionally, the invention includes detecting a printing device by broadcasting a request message over a network and receiving a response message from the printing device connected on the network.

The invention also preferably includes
35 publishing the newly created print queue to the
network. Additionally, it is preferable to create a
print queue entry in a print queue configuration

database that includes configuration data related to the print queue. Preferably a web page is created containing links representing each of the print queues with entries in the print queue configuration database.

5 By selecting a link on the web page, a user can preferably configure a workstation to print to the print queue represented by the link. It is also preferable to detect a new IP address of one of the printing devices and update both the configuration of
10 the print queue corresponding to the printing device and the configuration data in the print queue entry of the configuration database corresponding to the printing device. Finally, it is preferable to detect new identification information of a print queue and
15 update a connection between a network workstation and the print queue to reflect the new identification information.

By virtue of the foregoing, print queues are created and configured upon detection of a printing
20 device. In addition, changes in printing device addresses or print queue identification information are updated in the corresponding print queue configurations, and network workstations are notified of the changes. Accordingly, tedious and time
25 consuming tasks involved in the management of network printing devices are reduced.

This brief summary has been provided so that the nature of the invention may be understood quickly. A more complete understanding of the invention can be
30 obtained by reference to the following detailed description of the preferred embodiment in connection with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

35 Figure 1 is a depiction of a network environment in which the present invention may be practiced.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 depicts a network environment in which the present invention may be practiced. As seen in Figure 1, network 10 is provided which is a typical network that is supported by TCP/IP and other protocols as discussed further herein. Connected to network 10 are workstations 11 and 12, server 14, printers 15, 16, 17 and 18, laptop 19 and network management device 20. Network management device 20 is used to implement the present invention for managing a plurality of network devices, such as network printers 15, 16, 17 and 18. The configuration and functionality of network management device 20 is discussed in more detail below. In this regard, the invention is described below with respect to management of network printers; however, it should be appreciated that the present invention of network management device 20 can be used to manage any type of network device.

Workstations 11 and 12 are typical computing workstations having host processor 26 for supporting user interface 29, thereby allowing a user of either one of workstations 11 or 12 to work with typical applications, such as word processing, and to access functional services provided by other devices on network 10, such as printing services.

Server 14 is a typical server having host processor 30 which includes a large fixed disk for containing files and/or applications which can be accessed and shared by other users on network 10. Server 14 also has display 31 for supporting user interface 32. Laptop 19 is a conventional laptop computer having a host processor and display, thereby allowing it to operate in a manner similar to workstations 11 and 12.

Figure 2 is a block diagram for explaining the internal architecture of network management device 20. As seen in Figure 2, network management device 20

ROM 47 stores invariant instruction sequences, such as startup instruction sequences for CPU 41 or basic input/output operating system ("BIOS") sequences for the operation of any peripheral devices which may be attached to server 11 (not shown). Network interfaces 44 and 45 provide two separate and distinct network interfaces, thereby allowing network management device 20 to connect to two separate networks as discussed further below. As seen in Figure 2, network interfaces 44 and 45 each have respective protocols 48 and 49 for supporting communication of network management device 20 over network 10 with other devices on network 10. For example, protocols 48 and 49 can include, but are not limited to, TCP/IP, HTTP, SNMP, DHCP, and other known network protocols, including a variety of known printing protocols.

Front panel interface 46 provides the interface to front panel 21 provided on network management device 20, thereby allowing a user such as a system administrator to monitor and input configuration information and other commands and instructions to network management device 20.

Fixed disk 50 is one example of a computer-readable medium that stores program instruction sequences which are executable by CPU 41 so as to constitute operating system 51, front panel interface driver 52, network interface drivers 53, directories 54, servers 55, software modules 56, web pages 57, print jobs 58, print queue policy rules 59, print drivers 60, print queues 61, and other files 62. Operating system 51 can be an operating system such as DOS, or a windowing operating system for networks such as Windows NT, or can be another operating system such as Unix. Front panel interface driver 52 is provided for supporting front panel interface 46 to communicate with front panel 21. Network interface drivers 53 support network interfaces 44 and 45 for allowing network management device 20 to communicate with two separate networks, as discussed above. Directories 54 contain directories for use to implement the present invention for managing a plurality of print devices on the network and are discussed further below. Servers 55 contain necessary protocol servers and other servers for implementing the present invention and are discussed further below. Software modules 56 are utilized to implement the present invention as discussed further below. Web pages 57 comprise web pages which are accessible by users on network 10 or by a system administrator on network 10 to access functional services of printing devices on network 10 and to manage the configuration of network management device 20 and of a plurality of printing devices which are managed by network management device 20 as described further below. Print jobs 58 consist of print jobs received by network management device 20 from users on network 10, such as workstations 11 and 12, for sending to printing devices managed by network management device 20. Print queue policy rules 59 comprise a predetermined set of rules and/or rules

entered by a system administrator for governing how
print queues are created and published for each of the
printing devices which is managed by network management
device 20 as discussed further below. Print drivers 60
5 are print drivers for supporting the various printing
devices managed by network management device 20 and
print queues 61 are print queues created for the
printing devices management by network management
device 20. Lastly, other files 62 comprise other files
10 and applications necessary to implement the present
invention and to provide additional functionality to
network management device 20.

Figure 3 is a block diagram for showing the
contents of directories 54. Specifically, directories
15 54 includes device management directory 70, print queue
configuration directory 71 and services directories 72.
Device management directories 70 include one or more
device management directory which is used to store
network identification and configuration information
20 for each printing device managed by network management
device 20 and is explained in further detail below.
Print queue configuration directory 71 is a directory
which contains printer identification information and
printer capability information along with other
25 information for each print queue which is created
corresponding to a printing device managed by network
management device 20. Services directories 72 include
a variety of services directories for tracking and
managing the functional services supported by one or
30 more network management devices for the plurality of
printing devices supported by the network management
devices. Services directories 72 is discussed in more
detail below.

Figure 4 is a block diagram for explaining
35 the contents of servers 55. As seen in Figure 4,
servers 55 includes DHCP server 75, web server 76,
print server 77 and SNMP agent 78. DHCP server 75

allows network management device 20 to assign IP addresses to the plurality of printing devices which it manages, as well as to other devices on network 10. DHCP server 75 also has the capability to provide a software hook to which other modules can register. In this manner, when DHCP server 75 assigns an IP address to a printing device on network 10 and then receives an address acknowledgment message from the printing device, DHCP server 75 notifies, through the software hook, the registered software module of the IP address of printing device. This is used to trigger a discovery module to then perform targeted discovery of the printing device, as discussed more fully herein. In the alternative, network management device 20 can be configured to disable DHCP server 75 when an external DHCP server is utilized on network 10. This functionality is discussed in further detail below. Web server 76 is a typical web server and is used to publish web pages maintained by network management device 20 to other entities on network 10, such as workstations 11 and 12, or server 14. Print server 77 is a print server for managing print queues for one or more printing devices managed by network management device 20. Lastly, SNMP agent 78 allows network management device 20 to communicate with other network devices such as printing devices, over network 10 in order to send and receive network configuration information and other information related to the printing device. Preferably, SNMP agent 78 initiates SNMP communication between network management device 20 and other network devices which contain an SNMP agent for responding to the SNMP communications.

Figure 5 is a block diagram for explaining the contents of software modules 56 which includes DHCP listening module 80, virtual device modules 81, functional application modules 82, print queue service module 83, discovery module 84, and print queue service

manager module 85, and discovery service manager module 87. DHCP listening module 80 is a module which can be used when an external DHCP server is utilized outside of network management device 20, instead of DHCP server 75. In such a configuration, DHCP listening module 80 can be used to detect printing devices on network 10 based on the assignment of an IP address to a printing device by the external DHCP server. This functionality of DHCP listening module 80 is discussed more fully below.

Virtual device modules 81 comprise one or more virtual device module which can be initiated in correspondence to one or more printing devices supported by network management device 20 so as to extend functional capability of the printing devices. For example, a virtual device module may be executed to provide secure printing functionality on behalf of printing devices which are managed by network management device 20 and which do not have secure printing functionality embedded therein. It should be appreciated that such additional functionality can also be implemented in software without the use of a virtual device module.

Functional application modules 82 comprise modules for performing various applications such as network secure printing, and which interface with virtual device modules 81 to implement the functional services, such as secure printing, which are not directly supported by one or more printing devices managed by network management device 20. Functional application modules are discussed in more detail below. Print queue service module 83 interfaces with discovery module 84 to create a new print queue when a new printing device is discovered.

Discovery module 84 is a module which is used to perform discovery on detected printing devices on network 10 so as to obtain information regarding a

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printing device's network settings, and functional capabilities. Depending on the mode of operation of network management device 20, discovery module 84 can receive notification of a detected printing device
5 through a software hook from DHCP server 75, from classic discovery methods and/or from DHCP listening module 80. The functionality of discovery module 84 and print queue service module 83 is discussed in more detail below.

10 Print queue service manager module 85 is a management application which allows multiple network management devices on a same network to avoid confusion regarding the detection and discovery of printing
15 devices across the network and to distribute and share the processing load of supporting the various printing devices across the network between the multiple network management devices based on available resources of each network management device and based on the location of
20 each network management device within the network. Print queue service manager module 85 is discussed in more detail below. In a similar fashion, discovery service manager module 87 manages the discovery modules among multiple network management devices to prevent
25 confusion in the detection, discovery and management of printing devices. Discovery service manager module 87 also has the capability to distribute the load for performing discovery of printing devices on a given network between multiple network management devices. This functionality is discussed in more detail below.

30 Turning to Figure 6, web pages 57 is depicted which contains network configuration web page 86, queue service web page 88, and print queue web page 89. Network configuration web page 86 allows a user, preferably a system administrator, to have a web-based
35 interface for managing the configuration and operational parameters of network management device 20, or of multiple network management devices, at a single

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location. In addition, network configuration web page 86 allows a user, such as a system administrator, to configure and manage the printing devices which are managed by network management device 20. Queue service web page 88 allows a user, such as a system administrator, to access and manage the print queues for all printing devices managed by network management device 20 and by any other network management devices residing on network 10. Queue service web page 88 therefore allows a system administrator to view and manage all print queues supported by network management device 20 and other network management devices, and to view and manage print jobs within each respective print queue. Print queue web page 89 is a web page that is accessible to users of network 10, such as workstations 11 and 12, in order to publish in one location all available print queues managed by network management device 20 and any other network management devices on network 10 so that a user can quickly and efficiently find a needed print queue and can also download print driver corresponding to the printing device associated with a designated print queue.

Figure 7 is a block diagram for explaining one of device management directories 70. As seen in Figure 7, the device management directory is utilized for containing identification and network configuration information with respect to each printing device detected and discovered by the present invention. In particular, device management directory 70 contains a plurality of entries 90, each entry corresponding to a particular printing device which has been detected and discovered by network management device 20. Based on information discovered by network management device 20 from the respective device, a separate entry is created for the printing device and identification information related to the printing device, along with network configuration information of the printing device, is

stored in the entry. For example, each of entries 90 has a field for entering the MAC address 91 of the corresponding printing device. In addition, each entry has a corresponding print device type 92 and IP address 5 93 for the printing device associated with the entry. Lastly, network configuration information 94 contains network-related information associated with the printing device for the respective entry, such as domain name and other network setting information. In 10 this manner, a directory is provided for maintaining identification information and network configuration information of each printing device managed by network management device 20 for efficient access and management by a network user, such as a system 15 administrator. When more than one network management device is present across network 10, other device management directories are created to provide a common location for maintaining identity and network configuration information for all printing devices 20 managed by all network management devices on the network. This functionality is discussed in more detail below.

Figure 8 is a block diagram for explaining print queue configuration directory 71. In particular, 25 print queue configuration directory 71 contains a plurality of entries corresponding to each print queue which is created by the present invention for each printing device which is detected and discovered. When a print queue is created for a printing device, the 30 configuration information related to the print queue is stored in an entry in print queue configuration directory 71 to maintain all print queue configuration information in a common location. As seen in Figure 8, each entry in print queue configuration directory 71 35 corresponds to a separate print queue and contains information fields for IP address 100, MAC address 101, print queue name 102, printing capabilities 103 and

server 105. IP address 100 contains the IP address of the printing device corresponding to the print queue entry and MAC address 101 also corresponds to the MAC address for the printing device. Print queue name 102 is a name which is detected by discovery from the corresponding printing device or, if it is not detected, a name is generated when the print queue is created. For example, print queue name 102 may comprise a name which is simply the make and model of the printing device which is discovered by network management device 20 from the printing device. In a similar fashion, printing capabilities 103 contains printing capabilities of the printing device associated with the print queue entry. For example, printing capabilities 103 can include, but is not limited to, color printing capabilities, recording sheet-size capability such as letter and/or A4, and resolution capabilities. Server 105 is the identity of the network management device which is maintaining the print queue for a given printing device. For example, in a network environment having multiple network management devices, different print queues may be distributed among the multiple network management devices in order to balance the processing throughput and memory load required to maintain the print queues.

Figure 9 is a block diagram for explaining the functionality of network management device 20 in the network environment of network 10. As seen in Figure 9, DHCP server 75 is provided in network management device 20 for supporting DHCP communications over network 10 using the DHCP protocol. In particular, DHCP server 75 can be enabled, such as by a system administrator through front panel 21, to respond to all DHCP address requests on network 10 for an IP address. In this configuration, DHCP server 75 supports a software hook to which discovery module 84 has preregistered. When DHCP server 75 receives a DHCP

address request from a device on network 10, DHCP server 75 responds to the requesting device with an assigned IP address. When DHCP server 75 receives an address acknowledgment message from the requesting device, DHCP server 75 uses the software hook to notify discovery module 84 of the assignment of an IP address to the requesting device. Discovery module 84 can then determine if the requesting device is the type of network device that discovery module 84 should perform discovery on, and if so, discovery module 84 sends a discovery request message to the device to obtain information regarding the device's network settings, as well as device capabilities and configuration. A predetermined range of MAC addresses can be used by discovery module 84 to determine whether a device detected by DHCP server 75 is one for which discovery module 84 should perform discovery. In addition, a predetermined MAC address range may also be used by DHCP server 75 so that DHCP server 75 will only provide assigned IP addresses to a preferred set of network devices, such as network printers. Preferably, discovery module 84 compares the MAC address of the address acknowledgment message to the predetermined MAC address range to determine if the device is a network printer that should be discovered and managed by network management device 20.

In the alternative, network management device 20 can also be configured to disable DHCP server 75, such as by a system administrator either through front panel 21 or through network configuration web page 86. For example, when an external DHCP module is used DHCP server 75 is disabled to prevent addressing conflicts and discovery module 84 conducts classic discovery to discover all printing devices on network 10. Such classic discovery of the printing devices can include, but is not limited to, known techniques such as using broadcast discovery messages, pinging through a list of

IP addresses, router table walking, and DNS lookup. For example, an SNMP broadcast discovery message can be sent and then discovery module 84 can send a targeted SNMP discovery request to each responding printing
5 device. In the alternative, discovery module can ping through a list of IP addresses and then send a targeted SNMP discovery request to each responding printing device. As another alternative, discovery module 84 can obtain router tables from the routers on the
10 network and then send an SNMP discovery request to each printing device having an IP address in the routing tables. Lastly, discovery module 84 can obtain a list of assigned IP addresses from a DNS server on the network and then send an SNMP discovery request to each
15 printing device having an IP address in the list. It can be appreciated that other known methods of discovery can be used by discovery module 84 to discover printing devices on network 10 when an external DHCP server is used instead of DHCP server 75
20 in network management device 20.

In addition to classic discovery methods, DHCP listening module 80 can be used to detect an IP address acknowledgment message for a new requesting printing device on network 10. In particular, DHCP
25 listening module 80 detects DHCP address acknowledgment messages which contain an IP address for a new printing device on network 10. For example, after boot-up of network management device 20 in the configuration where an external DHCP server is utilized, discovery module
30 84 uses classic discovery methods as discussed above to discover the printing devices existing on network 10.

After using such classic discovery, DHCP listening module 80 can then be used to detect printing devices which subsequently become operational on
35 network 10 by detecting the IP address acknowledgment message sent from the DHCP server to the newly incorporated printing device to the external DHCP

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5 DHCP listening module 80 also uses a software hook, to
to which discovery module 84 has preregistered, to notify
discovery module 84 when a newly incorporated printing
device has been detected. Discovery module 84 then
initiates a discovery process for obtaining information
10 from the newly incorporated printing device, as
discussed in more detail below. DHCP listening module
80 can also use a MAC address range in order to listen
only for IP address acknowledgment messages
corresponding to a particular class of network devices,
15 such as network printers.

As discussed above, when an external DHCP server is used, discovery module 84 uses classic discovery methods to discover printing devices on network 10, after which DHCP listening module 80 can be used to discover subsequently incorporated printing devices. On the other hand, when DHCP server 75 is utilized, discovery module 84 is notified through the software hook from DHCP server 75 of a detected printing device. Regardless of the manner in which discovery module 84 becomes aware of a detected printing device, discovery module 84 initiates discovery of information from the printing device. Preferably, discovery module 84 sends an SNMP information request to the detected printing device by using the IP address of the detected printing device. The detected printing device then responds with an SNMP information message to provide the requested information to discovery module 84. Discovery module 84 creates an entry for each discovered printing device in device management directory 70. As discussed above, the entry corresponding to each discovered device in device management directory 70 includes the IP address,

MAC address, printing device type and network configuration information corresponding to printer 18. Discovery module 84 also notifies print queue service module 83 of each discovered printing device so that

5 print queue service module 83 can create a new print queue for the printing device and place the new print queue in print queues 61. Print queue service module 83 also creates an entry in print queue configuration directory 71 which contains identification information

10 for the printer, such as IP address, MAC address and printing device type, as well as a print queue name and printing device capabilities. In this manner, the network configuration of printing devices is easily managed and print queues are efficiently created and

15 maintained for the detected printing devices.

Although the block diagram of Figure 9 shows that network management device 20 is only using one of network interfaces 44 and 45 for connecting to network 10, another configuration is supported by network

20 management device 20 in which one of the network interfaces is used to connect to another network, such as a local network on which only printing devices reside. In such an environment, DHCP server 75 can be configured to respond only to IP address requests from

25 printing devices on the second local network, thereby leaving DHCP server 34 of server 14 to respond to all other IP address requests on network 10. In this manner, printing devices can be physically isolated from all other network devices on network 10 to prevent

30 unauthorized use and managed use of the printing devices connected to the second local network through network management device 20. The functionality of this embodiment is discussed in more detail below.

As also seen in Figure 9, web server 76

35 allows web pages such as those described with respect to Figure 6, to be published over the network to network users, such as a user at workstation 12 or a

In addition, network management device 20 can control a network device which it manages, such as a network printer, so as to reconfigure the network device for efficient operation under the management of network management device 20. For example, if a network printer is connected to network management device 20 over the local network, then network management device 20 can use SNMP messages to reconfigure the network printer. Such reconfiguration of the network printer can include, but is not limited to, instructions for the network printer to stop supporting certain protocols and to only use the protocol which network management device 20 uses to communicate with the network printer.

35 Figure 10 is a flowchart depicting a process
performed by network management device 20 to create
print queues corresponding to network printing devices

discovered on network 10. As discussed above,
discovery of network printing devices on network 10 is
coordinated through discovery module 84. In step
S1001, the discovery process is initiated when
5 discovery module 84 is activated by network management
device 20. In step S1002, discovery module 84
determines if network devices connected to network 10
have been detected and assigned IP addresses prior to
discovery module 84 becoming active. Checking for
10 previously detected network devices may occur in
different ways depending on the manner in which
discovery module 84 is being notified about newly
detected network printing devices. For example, if
DHCP server 75 is active and assigning new IP addresses
15 to requesting network devices, discovery module 84 will
query DHCP server 75 for all network printing devices
that have been assigned IP addresses prior to discovery
module 84 becoming active. On the other hand, if DHCP
server 75 is not active and an external DHCP server,
20 such as DHCP server 34, is being utilized to assign IP
addresses to requesting network devices, discovery
module 84 utilizes classic discovery methods (as
discussed above) to detect existing network devices.
Accordingly, discovery module 84 can identify all
25 network devices connected to the network and assigned
IP address prior to discovery module 84 becoming
active.

If there are no existing network devices on
network 10 when discovery module 84 is initialized,
30 discovery module 84 waits for notification of a new
device in step S1004. Notification received by
discovery module 84 may be limited to network devices
with specific IP addresses or specific MAC addresses in
order to limit which network devices on network 10 will
35 be supported by network management device 20. For this
embodiment, we are assuming that discovery module 84
will only be notified of newly discovered printing

devices. Notification of a new device may come in different ways as described earlier. For example, a software hook within DHCP server 75 will notify discovery module 84 of a new network device when an address acknowledgment message is received by DHCP server 75 from a network device that requested an IP address. In the alternative, when an external DHCP server is being used, DHCP listening module 80 will listen on network 10 for an address acknowledgment message from a network device requesting an address from an external DHCP server and notify discovery module 84 of any such network device. Regardless of the manner in which discovery module 84 is notified of a new printing device, the notification includes sufficient identification information of that printing device to allow discovery module to communicate with the printing device. Such information might include, but is not limited to, the IP address and the MAC address of the newly detected printing device.

20 If discovery module 84 has been notified of a new printing device, or in step S1002 an existing printing device has been found, the print queue creation process proceeds to step S1005 where discovery module 85 obtains additional information from the printing device. For purposes of this description, assume that printer 18 is a newly detected printing device. In step S1005, discovery module 84 sends an information request message to printer 18 via SNMP agent 78 using the IP address provided in the notification. In response to the request message, printer 18 sends a response which includes information including, but not limited to, the type and model of printer 18, as well as information regarding the available functions and capabilities of printer 18.

35 The information might also include available paper sizes, color capabilities, print speed, resolution, etc. As discussed above, discovery module 84 uses this

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5 creating and configuring the particular print queue.

configured by print queue service module 83, the print queue is registered with print server 77. Print server 77 then proceeds to publish and make the print queue available to client workstations connected to network 10 using conventional protocols such as SMB. In addition, print server 77 may utilize print queue policy rules 59 to regulate use of the print queues by client workstations connected to network 10.

25 management devices connected on network 20 are
published in a single location. Web server 76 is used
to publish print queue web page 89 over network 10,
thereby allowing a network user to access the listing
of available print queues using either a workstation,
30 like workstation 12, or a server, like server 14.

opened at workstation 12 using user interface 29 and a
conventional browser installed on host processor 26.
Viewing print queue web page 89, a network user at

Selection may be performed by typing in the print queue name within user interface 29 or by selecting a link associated with the desired print queue within print queue web 89 page using a pointing device such as a mouse.

In the course of managing a computer network, network devices may need to be relocated or replaced. When a device is relocated, it may need to have a new IP address assigned to it for communication within the network. In addition, when dynamic hosting protocols

In the course of managing a computer network, network devices may need to be relocated or replaced. When a device is relocated, it may need to have a new IP address assigned to it for communication within the network. In addition, when dynamic hosting protocols

such as DHCP are used to administer IP addresses, situations may arise where a network device is assigned a new IP address. If a network printing device is assigned a new IP address, it is essential that the print queue associated with that printing device is updated with the new IP address in order to maintain consistency for the client workstations connected to that particular print queue for printing purposes. The flowchart depicted in Figure 12 demonstrates a process for automating the task of updating print queue configurations with new IP addresses.

As described with reference to Figure 10, either by DHCP server 75 or by DHCP listening module 80 detects the assignment of IP addresses to network devices and notifies discovery module 84. For the purposes of this example, assume printer 18 has been relocated on network 10 and is assigned a new IP address by DHCP server 75. In step S1201, the assignment of an IP address to printer 18 is detected. In step S1202, discovery module 74 is notified that printer 18 has been assigned a new IP address, and discovery module 84 is provided with the IP address assigned to printer 18 and the MAC address of printer 18.

Upon receiving notification that printer 18 has been assigned an IP address, in step S1203 discovery module 84 compares the MAC address of printer 18 with those listed in the entries of device management directory 70. Since printer 18 was previously connected to network 10, an entry is found under the MAC address of printer 18 together with its previous IP address. Using the pair of address (IP and MAC) from the entry, print queue service module 83 can identify a previously created print queue associated with printer 18 by referring to print queue configuration directory 71. Once the print queue is identified, the process proceeds to step S1205. In

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functions including, but not limited to, manually creating or removing print queues, pausing and resuming the operation of a print queue, purging a print queue, and editing the driver associated with a print queue.

5 In addition, queue service web page 88 allows a user to manage individual print jobs within individual print queues. For example, a print job may be paused, restarted, cancelled or reordered. Accordingly, queue service page 88 affords a user a large amount of
10 control over print queues associated with the printing devices of network 10.

As mentioned above, queue service web page 88 allows a user to manage existing print queues on network 10. Using queue service web page 88, an
15 administrator may rename the queue associated with printer 18 using queue service web page 88. However, if the name of a print queue is changed, all network devices, such as workstation 12, that use that particular print queue, will no longer have a
20 connection with printer 18. Each network device with a connection to printer 18 must learn the new print queue name of the print queue associated with printer 18, and the configuration on each network device must be modified to reflect the new print queue name.
25 Additionally, a network administrator may reassign a particular print queue to a different server during network administration or to provide for load balancing. As with changing the name of a print queue, all network devices with a connection to printer 18
30 must have their connection updated to reflect the new server in order to continue to use printer 18 corresponding to the particular print queue.

Figure 13 is a flowchart depicting a process for updating print queue connections when the
35 identification information of a print queue has been changed. For example, the name of a print queue may be changed to provide for easier identification of a

5 available on the network. Regardless of the type of
change, when the identification information of a print
queue is modified, client workstations on the network
will no longer be able to send print jobs to the
modified print queue until their connections have been
10 updated.

The procedure for updating a print queue connection, described with reference to step S1305 above, may vary depending on the network configuration or the protocol used for communicating between the client workstation and the printer. For example, when a print queue is modified, network management device 20

The procedure for updating a print queue connection, described with reference to step S1305 above, may vary depending on the network configuration or the protocol used for communicating between the client workstation and the printer. For example, when a print queue is modified, network management device 20

may simply notify software installed on the identified client workstation of the new identification information using a protocol such as SNMP. The software would then update the configuration on the client workstation. Alternatively, the client workstation may allow remote configuration thereby allowing a network administrator or a module within network management device 20 to remotely configure the client workstation with the new identification information of the print queue. Other embodiments may utilize other protocols such as LPD, providing a level of indirection and allowing the connection configuration to be updated within the print server. Regardless of the updating method being used, the present invention maintains the connection between a client workstation and a print queue without requiring action from a network user of the client workstation.

As mentioned above, using queue service web page 88, an administrator can manually create a print queue for a network printing device. While the present invention can automatically detect a new printing device and create a print queue for that printing device, situations may arise where manual creation of print queues is required. For example, the auto-create feature of the invention may be disabled by an administrator via queue service web page 88. Additionally, an administrator may designate a maximum number of printing devices or may designate an IP address (or MAC address) range of printing devices to be supported by network management device 20 using queue service web page 88. Upon being notified of a new printing device by discovery module 84, print queue service module 83 will not proceed with the automatic creation of a print queue when the existing number of print queues being supported by network management device 20 has reached a maximum number set by a network administrator or if the IP address (or MAC address)

falls outside of a predetermined range. If an administrator wishes to add another print queue under these situations, as well as others, manual creation of the print queue must be performed using queue service web page 88. Figure 14 depicts a process for manually creating a print queue for a network printing device.

In step S1401, a user, preferably a network administrator, selects manual print queue creation using queue service web page 88. Queue service web page 88 then provides an interface for the user to create and configure a print queue for a particular network printing device. In step S1402, the user is given the option of creating a print queue for either a previously discovered printing device or new printing device. If the user selects creating a print queue for a new printing device, the user then provides identification information about the printing device in step S1404, thereby allowing network management device 20 to contact the printing device over network 10 to obtain additional information from the printing device. The provided identification information includes, but is not limited to, the IP address of the printing device as well as the type of printing device.

If the user opts to create a print queue for a previously detected printing device in step S1402, the user is provided with a list of current printing devices. The list is generated by referring to device management directory 70, which as described above, contains an entry for each network device detected by network management device 20. The user then selects from the list of current printing devices in step S1405. Alternatively, the list from which the user selects a printing device could be generated by discovery module 84 performing one of the classic discovery methods discussed earlier to compile a current list of network devices. Once discovery had been completed by discovery module 84, the list would

then be generated and displayed for the user to select from.

After the user has entered identification information for the printing device in step S1404, or selected a current printing device in step S1405, the process proceeds to step S1406 where the parameters required for configuring the new print queue are obtained. Discovery module 84 obtains additional information from the printing device using a service such as SNMP agent 78 as described above regarding step S1005 in Figure 10. Additionally, the user is prompted for information needed to establish other properties of the print queue such as load balancing, fail over printing, automatic share reconfiguration, etc. Once all the necessary information has been obtained from the printing device and the user, print queue service module 83 is provided with the obtained information and instructed to create a print queue in step S1408. In step S1408, Print queue service module 83 creates a print queue in the manner described above regarding step S1008 in figure 10.

The present invention has been described with particular illustrative embodiments. It is to be understood that the invention is not limited to the above-described embodiments and the various changes and modifications may be made by those of ordinary skill in the art without departing from the spirit and scope of the invention.